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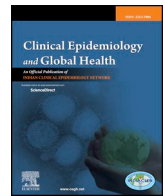


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Comparison of the prevalence of *Toxocara* spp. eggs in public parks soils in different seasons, from 2017 to 2018, Tehran Province, Iran

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ABSTRACT

Background and objectives: Toxocariasis is one of the most important pathogens transmitted to humans through the soil. Temperature 12–37 °C provides the best conditions for infecting eggs to be transmitted to humans, dogs, and other hosts. This study is preliminary in order to detect *Toxocara* eggs in public park soils and to study the correlation between seasons and climate variation with contamination rate.

Methodology: A total of 1132 soil samples were collected over the course of the year, from 11 major parks. A centrifugal-floatation technique with the utilization of saturated sodium nitrate solution was used to examine the soil samples to recover *Toxocara* spp eggs.

Results: Out of 1132 samples collected from public park soils, 129 (11.39%) samples were positive for *Toxocara* spp eggs, Laleh Park in south part showed the highest contamination rate. Contamination rate varied according to the site of parks, location with the highest rate in the south followed by center and the prevalence of eggs is high in spring and autumn without significant association. The prevalence of *Toxocara* spp eggs in soil associated significantly with Average temperature and rainfall ($P = 0.04, 0.001$ respectively).

Conclusion: According to our study findings, soils of the public parks in Tehran showed as one of the main sites for contamination with *Toxocara* spp eggs. The prevalence of soil contamination varied according to a climate of different seasons, spring and autumn climate such as temperature and rainfall rate were considered as optimal condition for eggs development and to survive.

1. Introduction

Soil-transmitted helminths (STH) are still one of the most significant public health issues. STH includes ascariasis, trichuriasis, ancylostomiasis, necatoriasis, strongyloidiasis, and toxocariasis. The prevalence rate of STH infections varies significantly due to variations in socioeconomic conditions; climate and other environmental factors.¹ pre-parasitic stages of STH prefer wet climate seasons which help it to survive and increases in transmission, while dry climatic conditions kill

infective stages on the soil surface.² STHs infection was showed higher prevalence rate in rainy season compared to summer season.^{3,4} *Toxocara* spp are worldwide distributed zoonotic parasite of domestic animals which may lead to various form of the disease in paratenic hosts. According to the American Centers for Disease Control and Prevention (CDC), human Toxocariasis recognized as one of the top five neglected parasitic diseases.⁵ Toxocariasis in humans is caused by accidental ingestion of *Toxocara* ova from the environment.^{6,7} Public places such as parks, playgrounds, and sandboxes are the main areas of the helminthic

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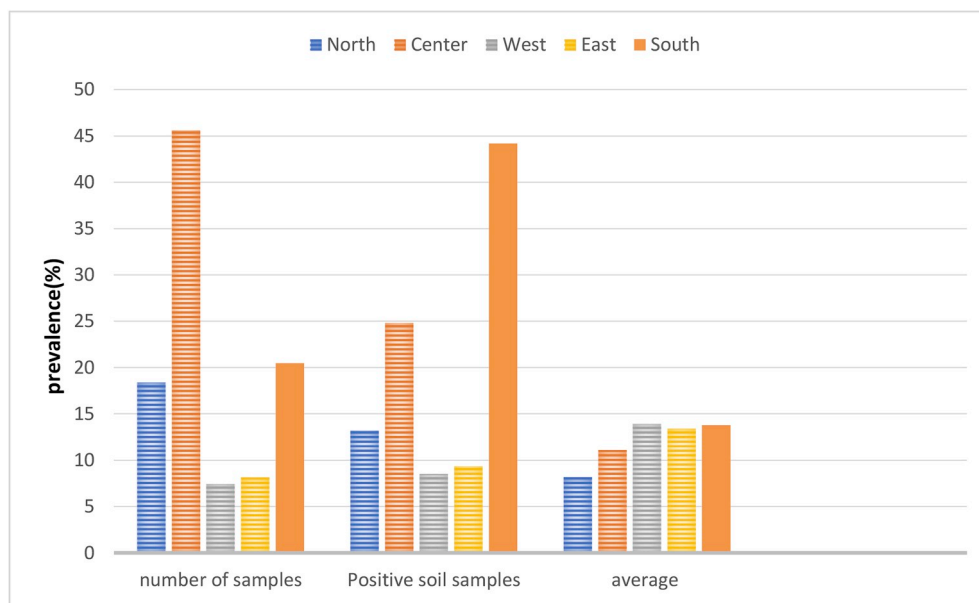


Fig. 1. Prevalence of Soil contamination with *Toxocara* spp egg in public parks, according to different park location in Tehran.

eggs transmission because of those areas recognized as the most common places for pets walking and erratic dogs and cats.⁸ The detection of *Toxocara* eggs in public soils have been reported in last studies in different parts of Iran, the condition of soil contamination in Tehran is not precisely known; also the correlation of seasonal variation with the prevalence of Toxocariasis in soil has not been detected. Thus, the current study was performed to determine the prevalence rate of *Toxocara* eggs in the public park soils in Tehran Province, Iran and study the effect of season variation and climate on the prevalence of *Toxocara* eggs in public soil.

2. Materials and methods

2.1. Study region

Tehran (35°41'21"N 51°23'20"E) is the capital of Iran and Tehran Province (Fig. 1). With a population of around 8.4 million in the city as a most populous city in Iran and western Asia. Tehran has a cold, semi-arid climate and a Mediterranean rain pattern which has about 300–305 mm of annual rainfall. Since the difference between altitudes in different parts of Tehran is significant, the weather in the mountainous north is much colder than the southern part of Tehran. Also, rainfall and humidity will be different. Seasonal changes in Tehran are very tangible. Summer is long, warm and dry, and rain is low, but it can make the heat more durable due to its low relative humidity. Temperatures average are between 90 and 106 °F, that it can drop to 14 °C in the mountainous north of the city at night. July and June are the hottest months, with an average temperature between 91 °F and 100 °F, and the coldest is January when the temperature varies from 23 °F to 34 °F.

2.2. Samples collection and soil recovery

A total of 1132 soil samples were collected seasonally (every three months) from 11 major parks were selected based on factors such as municipal district, park area size and population traffic flow (from 02 October 2017 to 16 September 2018). Sampling was carried out randomly from every 50 steps and 10 g from of 3–5 cm ground depth which eventually includes 500 g of each area then the samples were thoroughly mixed and placed in sealed and labeled plastic baggage and transported to the laboratory. The soil samples were dried at room

temperature for 2–3 days and passed through a 150 µm mesh sieve.

2.3. Detection of *Toxocara* spp eggs

To recover *Toxocara* spp. eggs, the soil samples were examined by a centrifugal-floatation technique with the utilization of saturated sodium nitrate solution. Briefly, 20 g of the soil sample was placed in an associate Erlenmeyer's flask containing 50 ml of 5%NaOH (Merck, Germany) mixed and left for 1h to separate eggs from the soil. The samples were then vortexed for 10 min; the suspension was transferred to falcon tube and centrifuged at 1500 rpm for 3 min. The supernatant was discarded and saturated NaNO₃ (Merck, Germany) with a selected gravity of 1.30 was added and centrifuged once more at 1500 rpm for 3 min. Finally, the Na–NO₃ was superimposed on the tube to form cartilage and a coverslip was overlaid. After 30 min, the coverslip was transferred onto a microscopic slide. The preparations were evaluated for the presence of *Toxocara* spp. eggs below the light microscope at 100× and 400× magnification. Furthermore, Positive samples were also randomly examined by formalin-ether method (In more than 90% of the random samples with both techniques were positive). Supported the size and morphology, the parasites were indicated as *Toxocara* spp. eggs. Data analysis was done through SPSS, statistical software version 20.

2.4. Statistical analysis

Analysis of data on the relationship between seasonal variations and parasitic load changes in soils was evaluation using SPSS version 20 software and chi-square test. Probability (P) values of less than 0.05 were considered to be statistically significant ($P < 0.05$).

3. Results

After examining all sample of eleven parks, according to geographical area, it was shown that the contamination rate was variable, so that the Daneshjoo and Chitgar park from the center and west of the city have the least pollution (3.9%) and the most rate related to the Laleh park from center of the city (Table 1). Regarding of embryonated eggs, the total number of positive specimens was found to be 129 (11.39%).

Table 1

Number of positive samples in different types of parks.

	Location in the city	Number of samples	Positive soil samples(N)	Percent (%)	Prevalence Ratio	P-value
Mellat	North	112	10	7.75	1	
Chess	North	96	7	5.43	0.6	
Shahr	Center	128	11	8.52	0.7	
Daneshjoo	Center	56	5	3.9	0.75	
Abrisham	Center	84	9	7.0	0.9	
Laleh	Center	168	22	17.05	1.3	
Saei	Center	80	10	7.75	0.95	
Piroozi	East	92	12	10.75	0.8	
Chitgar	West	84	11	8.5	0.65	
Besat	South	124	20	15.5	1.7	
Bahman	South	108	12	10.75	1.2	
Total		1132	129	100		0.055

Table 2

Separation of positive samples by season.

	Spring	Summer	Autumn	Winter
Mellat	4	2	3	1
Chess	3	2	2	0
Shahr	4	2	4	1
Daneshjoo	3	1	1	0
Abrisham	3	1	4	1
Laleh	9	3	7	3
Saei	3	2	4	2
Piroozi	4	2	5	1
Chitgar	5	2	2	2
Besat	8	4	6	2
Bahman	3	2	4	3
Total positive	48 (37.2%)	23 (17.8%)	42 (32.6%)	16 (12.4%)
Total sample	321 (28.36%)	266 (23.50%)	347 (30.65%)	198 (17.49%)
Prevalence ratio	1	0.7	1.1	0.67
P-value				0.086

3.1. Seasonal soil contamination with *Toxocara spp* egg

Soil samples had the highest of contamination in the spring (37.2%), and on the other hand, we detect the lowest pollution in winter (12.4%). The examined soil samples in the autumn and summer season had shown the 32.6% and 17.8% of contamination respectively. Details of soil contamination data by season are shown in Table 2 and Fig. 2.

Tables 3 and 4 show that the highest prevalence of soil

contamination was reported with an average temperature of 12.33 °C and an average rainfall of 16.66 mm results showed that the highest soil contamination was in autumn (30.65%).

By analyzing the correlation between the rate of *Toxocara spp* eggs contamination in the parks and the sampling season, it showed that there was no significant relationship between them and this relationship is statistically meaningless. Based on the type of environment, we divided the samples into four categories: garden, garbage, grass and

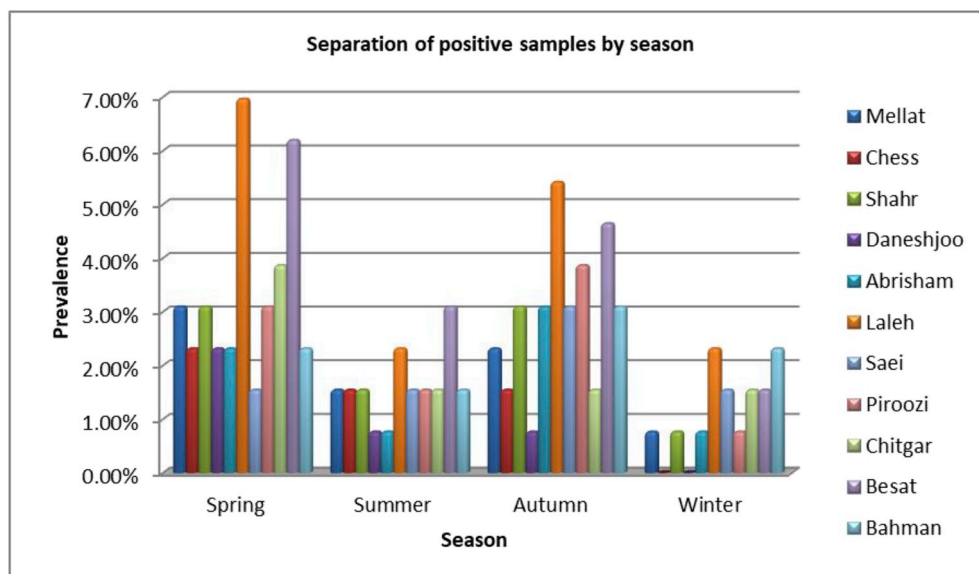


Fig. 2. Mean prevalence of Soil contamination with *Toxocara spp* egg in public parks of Tehran, Iran.

Table 3

Toxocara spp egg prevalence in soil samples based on the average temperature of different season (www.holiday-weather.com).

	Spring	Summer	Autumn	Winter	p-value
Prevalens (%)	28.36%	23.50%	30.65%	17.49%	0.040
Average temperature (°C (22.66°C	28.66°C	12.33°C	7°C	

Table 4

Toxocara spp egg prevalence in soil samples based on the average rainfall of different season (www.holiday-weather.com).

	Spring	Summer	Autumn	Winter	p-value
Prevalens (%)	28.36%	23.50%	30.65%	17.49%	0.001
Average rainfall (mm (13.33 mm	10 mm	16.66 mm	33.33 mm	

children playgrounds. The highest amount of contamination was in the garden area with a rate of 39.54% and the lowest amount was related to garbage, which results are proportional to the number of samples from each section. (Table 5). Contamination rate of garden areas is considered statistically significant (p-value < 0.05).

4. Discussion

In this current study, we investigated the prevalence of Toxocariasis in public park soils among 11 major parks in Tehran province, Iran using the flotation technique. The recovery of *Toxocara* eggs from soil samples of the public parks relying on several potential environmental factors such as temperature, humidity, sunlight, the source and site of soil samples, and the diagnostic technique.⁹ *Toxocara* spp eggs need time in suitable environmental conditions to be infectious to paratenic hosts.¹⁰ Our study showed that the contamination rate with *Toxocara* spp. eggs of 11.39% (129/1132 soil samples) in soil samples collected from public parks in 11 major different locations of Tehran. In agreement with¹¹ who reported that the prevalence of *Toxocara* spp. eggs in public park soils in Tehran 10%. In contrast with other studies in different parts in Iran has been reported, such in Abadan (29.2%)¹²; Khoramabad 22.2%¹³; and Shiraz 6.3%.¹⁴ Furthermore, On average, the prevalence of toxocariasis in Iran has been less than 16% in humans and about 20% in animals in various studies.¹⁵ Our study findings showed that the prevalence of soil contamination with *Toxocara* spp. eggs varied with site and location of the soil samples, Laleh showed the highest soil contamination rate followed by Besat then Bahman (17.05%, 15.5%, and 10.75% respectively) this difference in prevalence with the site not statically significant. The prevalence rate of soil contamination showed that the prevalence is high in South part followed by the center, In agreement with¹⁶ who reported high prevalence of *Toxocara* eggs in Stara Zagora region South Bulgaria. Public parks and playgrounds are more susceptible to pets and stray animals and cause infection transmission to human and uninfected animals. Pets are attended to public places to defecate, thereby contaminating the soil. Public parks were reported as the most contaminated place with

Toxocara eggs than the playgrounds.^{13,17} Our findings showed that the contamination rate is higher in the garden (39.54%) followed by grass (27.9%). *Toxocara* contamination prevalence varied over the course of the year, infection rate may vary depending on the season.^{18,19} In this study the prevalence of *Toxocara* eggs detection in soil carried with seasons with higher prevalence in spring (37.2%), autumn (32.6%), In agreement with Some researchers who noticed that the presence of *Toxocara* eggs in sandpits located in Japan public parks, reporting a higher prevalence of eggs recovering during the autumn, spring and early summer.²⁰ In addition to in other countries, the highest egg prevalence have detected in these seasons^{21,22}) which is may be connected with the reproductive period of the definitive hosts in these seasons. In contrast with²³ who reported the period of higher prevalence of egg recovered peak was during the winter. Temperatures and rainfall were associated factors with eggs survival. Our study was conducted when temperatures are varied from 7 to 28.66 °C in Tehran Province Iran with high prevalence in temperature between 12.33 and 22.66 °C, temperature showed significant association with *Toxocara* egg prevalence (P = 0.04). Previous studies have reported that the temperature ranges from 23 to 30 °C is the optimal temperature for *Toxocara* egg development in soil.²⁴ Rainfall rate in our study showed significant association with *Toxocara* egg in soil (P = 0.001), low rate of rainfall is favorable for eggs survival and contamination rate, the best rate reported at 13.33–16.66 mm rather than high rainfall in winter. In agreement with²⁵ who reported that the low rainfall rate was favored for the eggs extinction.

5. Conclusion

To conclude, the current study revealed that the contamination rate of Public Park soils in Tehran with *Toxocara* spp. eggs (11.39%). According to our data, there is a relatively high prevalence of *Toxocara* eggs in spring and autumn due to variation in temperature and rainfall. It should prevent the entrance of domestic animals (dogs and cats) into parks due to the presence of contamination in the area's soils and provide people with the necessary knowledge about toxocariasis-infected pathogens.

Author's contribution

Study concept and design: VR, VS, MZ, AI, acquisition of data: SB, EA, OR, RA,VS, analysis and interpretation: VR, AI, LS,AG.

Ethical statement

All steps are from sampling to analysis of results according to approved and standard protocols.

Declaration of competing interest

The authors and coauthors declare that they have no conflict of interest that affects this study.

Table 5

Number of positive samples based on the type of environment.

Environment	Number of samples N (%)	Number of positive samples N (%)	Prevalence Ratio	P-value
Garden	406 (35.87%)	51 (39.54%)	1	
Garbage	84 (7.43%)	17 (13.18%)	2.08	
Grass	399 (35.24%)	36 (27.9%)	0.71	
Children playground	243 (21.46%)	25 (19.38%)	0.88	
Total	1132 (100)	129 (100)		0.166

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